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Black Locust in Pennsylvania

A 40-Year-Old Black Locust Grove—An Asset to Any Farm

THE PENNSYLVANIA STATE COLLEGE
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Black Locust in Pennsylvania

Arthur G. McIntyre

ORIGINALLY, black locust was found only in the central and southern portions of the Allegheny Mountains (8) but, because of its popularity for ornamental and shade tree planting and for the production of fence posts and other forest products, it has been planted generally throughout the state, and is now commonly found along the fence rows and highways of many parts of Pennsylvania. The earliest known extensive planting of black locust was about 1858 on what is now called the Fox Estate, near Foxburg, Pennsylvania. Since then plantations have increased rapidly. Several railroads have planted many thousands of black locust seedlings along their tracks for the production of ties and fence posts.

The black locust[1] is one of our most valuable and rapidly growing hardwoods. Because of its spreading root system and adaptibility to most soils, it takes first place among all trees in ability to check erosion in gullies and on steep hillsides. The early settlers soon recognized its value for fence posts. Instances are known where black locust fence posts were sufficiently sound after 40 years of service to permit resetting.

Characteristics

Black locust is not exacting in its soil requirements (2-8-10-11). It is found on nearly all soil types within the state. It does best on moist, fertile loams, such as are found on bottom-lands and along streams, but it also flourishes on the thin, rocky soils characteristic of our mountain slopes. It stands drought well. The species is aggressive. It produces an abundance of seed, sprouts, and suckers, thus insuring reproduction.

Black locust growing in plantations or in mixture with other trees has a fairly straight and clean trunk. When growing in the open, as along fence rows, it shows a marked tendency to fork, developing a low spreading crown. When soil and light conditions are favorable it makes rapid height growth.

The light feathery leaves are compound, with 7 to 9 leaflets, dark green in summer, turning to a pale yellow in late fall. Small thorns borne in pairs at the nodes, the light, grayish-brown, smooth bark of young trees, and the rough, irregular furrowed, reddish-brown bark of the older trees are distinct winter characteristics. The abundance of fragrant white blossoms appearing in June and the seed pods, containing many black bean-like seeds, also offer easy identification of this useful and ornamental tree.

The tree is a legume, belonging to the same family as clover and alfalfa; impoverished soils may be improved by growing a crop of black locust on them.

[1] *Robinia pseudoacacia*, Linnaeus, is known in Pennsylvania by several common names, the principal ones being black locust, yellow locust, common locust, white locust, locust, and acacia (8). The species is known by 11 common names throughout the United States (14). Two kinds of heartwood are produced, one being an olive brown and the other a yellowish green. This difference in the color of the woods has given rise to two distinct common names, the darker wood being called black locust and the lighter wood yellow locust (12). No botanical characteristics have been found to distinguish the two forms. Sixteen varieties are recognized in cultivation (12).

Uses

The wood of black locust is heavy, hard and strong. Heartwood is formed early in the life of the tree, very little sapwood being present in stems large enough for posts. The wood is straight grained, seasons well, splits readily, holds its shape, and does not check. Of untreated woods used in contact with the soil, black locust ranks among the first in durability. Its most common use is for fence posts.

Black locust timber is prized for bridge construction. It is used in the manufacture of vehicles and implements, for railroad ties, insulator pins, turning stock, and tree nails. On the farm, it often displaces hickory for wagon tongues, double trees, whipple trees, reaches and neck yokes. Many wood piles contain black locust.

Propagation

Growing From Seed.—Black locust seed is very viable. It may be collected or purchased. When properly stored, or planted immediately, over 90 per cent germination may be expected. There are about 26,000 seeds in a pound. The seeds have a hard hull or outer covering. Germination will be hastened if the seeds are soaked prior to planting, they should be placed in a bucket, hot water poured over them, and then allowed to stand overnight.

In growing black locust seedlings in seedbeds, well-drained loamy soil should be selected. The soil should be worked thoroughly prior to planting. Shaded locations should be avoided. The seed may be sown about one inch apart and ¾ to 1 inch deep, in rows spaced from 1½ to 2 feet apart. Seedbeds should be kept free from weeds and the soil well worked during the growing period (9). Seeds sown in April or May will produce seedlings for the following fall or spring planting. One-year-old seedlings often attain a height of several feet, but large stock is not desirable. The trees should be cut off at the ground line prior to, or just following, planting.

Growing from Seedlings.—Black locust seedlings may be purchased from nurserymen or from the Pennsylvania Department of Forests and Waters. When seedlings are purchased, they should be planted promptly or unpacked and heeled in. In heeling in, a trench is dug and the bundles of seedlings placed so that their roots may be completely covered with soil. The soil should be damp and kept in a moist condition until the seedlings are used. The stock should be planted early in the spring before the buds begin to open.

Planting

One-year-old seedlings from 12 to 24 inches in height are the most desirable size for planting. Every precaution should be taken to prevent the roots from drying out. During planting they should be carried in buckets containing wet moss or mud. April and May are the best months for planting, though late fall plantings may be successful. Areas are often plowed prior to planting, and this is desirable if a heavy sod is present. Plantations are sometimes cultivated during the first few years (9-13). It is questionable, however, whether soil preparation or cultivation gives results commensurate with the cost of such work.

FIG. 1. IN SOD LAND, THE PLOWING OF FURROWS FACILITATES PLANTING AND REDUCES LOSSES

Excellent results have been attained by turning single furrows and setting the stock in the bottom of the furrows after the soil has settled. In order to guard against losses arising from the soil caving in along the furrows and smothering the seedlings, plowing should be done in the fall for spring planting.

In planting, holes should be made large enough to permit spreading of the roots. The soil should be packed firmly around the roots and the stem left in an upright position. Mattocks or grub hoes are excellent tools for planting. Where one man works alone, the small, short-handled mattock is ideal.

Planting costs vary with the type of planting tool used, size of stock, experience of planters, and condition of planting area. One man working in loose soil with the light one-man mattock can plant about 1,000 seedlings a day. For the inexperienced planter, however, 500 seedlings a day is a good average. The larger the stock the more time is consumed in setting because large seedlings require large holes if the roots are to be properly spread out. Planting in sod is slow work because of the effort required to dig the holes.

Spacing.—In spacing, two objectives are sought; the plantings should be sufficiently close to insure early crown closing and shading of the trunks and ground, and the spacing should result in maximum growth without resorting to early thinnings. A spacing of 6 by 6 feet seems to meet these two requirements (note tables). Closer spacing than 6 by 6 feet will result in the crowns closing at an earlier date, but stagnation may result unless early thinnings are made (2-7-11-13). The more trees planted per acre, the greater the cost. It is apparent from Table 2 that as the stand grows older the loss increases.

Fig. 2. An 8-Year-Old Black Locust Grove That Averaged 59 Posts Per Acre; Crowns are Closed and Favorable Conditions Prevail

The diminishing number of trees per acre is due to storms, insects, fungi, and the struggle of the trees among themselves for moisture, light, and food. Such losses will continue throughout the life of the stand. Wide spacing is not desirable. Plantations made with spacings of 10 by 10 feet or greater may be subjected to borer attacks; they become excessively weedy and develop many crooked, forked boles (1-6-7-13). Irregular spacing, such as 2 by 6 or 4 by 8, is poor practice (11). Such spacing tends to produce leaning boles because the trees will grow toward the greater openings and light.

Mixed Plantings.—The purpose of mixed plantings is to produce and maintain good forest condition. Trees heavy with foliage, in mixture with locust, give sufficient shade on tree trunks to aid in the control of the locust borer and maintain good forest floor conditions. On good sites and in localities where the locust borer is not a serious pest, pure plantings give satisfactory results. When mixed plantings are to be made, suitable "filler" trees should be chosen, such as red oak, white ash, basswood, yellow poplar, hard maple, and Norway spruce. Black locust, being a light-demanding tree, never should be planted in mixture with species whose height growth is more rapid than that of locust. Plantings may be made in checker board fashion or by alternate rows.

In a 21-year-old mixed planting, spaced 6 by 6, the following figures were obtained: on an acre basis there were 224 black locust trees whose average D. B. H.[1] was 2.8 inches and average height 26.7 feet; 256 red oak averaged 3.4 inches D. B. H. and 29.8 feet in height; 144 white oak averaged 3.0 inches D. B. H. and 25.0 feet in height. A few larch had been planted, but only one remained, which had a D. B. H. of 3.0 inches and measured 22.0 feet in height. The crowns had closed and the tree

1 Diameter breast high.

FIG. 3. THIS TREE HAD A D. H. B. OF 4.5 INCHES AND WAS 32 FEET TALL AT EIGHT YEARS OF AGE

trunks and ground were well shaded. These data show that the height growth of the various species was about the same. Because of the density of the stand, diameter growth is less than average.

Care of Plantations

Black locust, when growing in closed stands, is practically self pruning. Plantations will be improved if occasional prunings and thinnings are made, removing dying limbs and trees of poor form and shaping up the

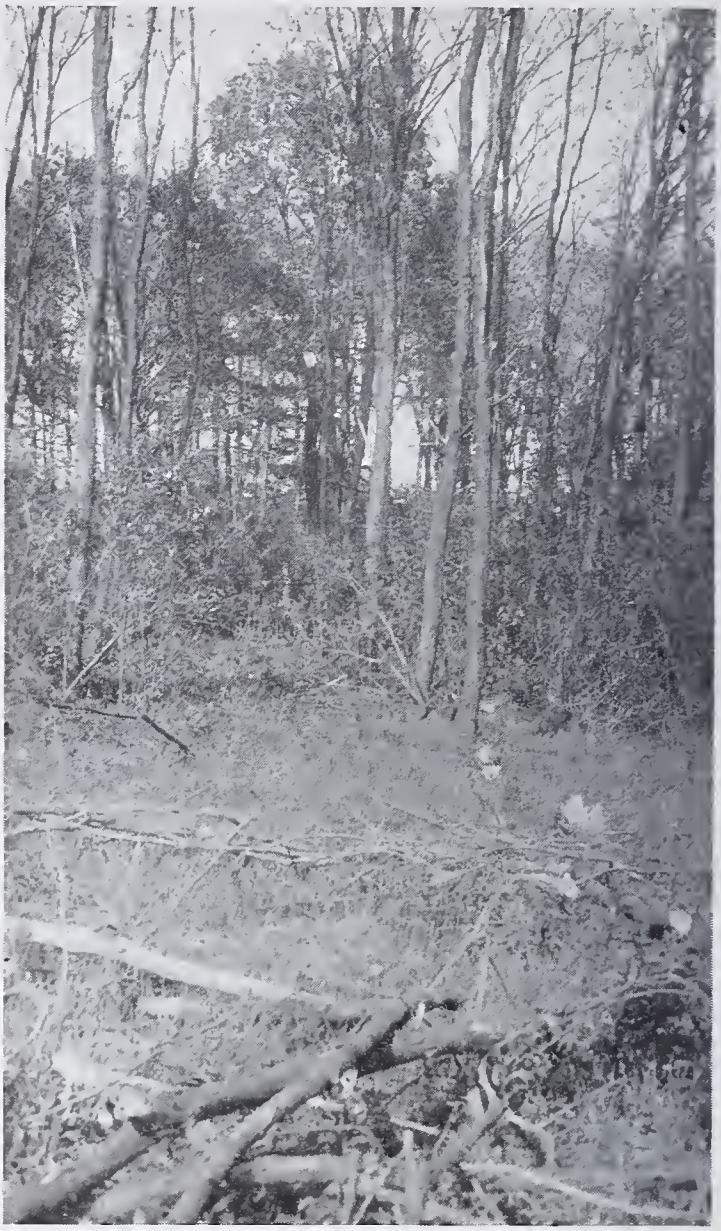

Fig. 4. An 18-Year-Old Black Locust Grove Partially Clear Cut. Note Low Stumps in Foreground

better stems by eliminating forks. Young locust trees exhibit a decided tendency to fork. In one 5-year-old stand spaced 6 by 6 feet, 76 per cent of the stems were forked within six feet of the ground and of these over 50 per cent would grow into forked or poorly shaped trees unless cared for. Another plantation seven years old, spaced 4 by 6 feet, showed 81 per cent of the stems forked within six feet of the ground. These plantations should have been inspected during the first few years of growth and the irregular stems removed or pruned.

The question invariably arises, "Does it pay in dollars and cents to prune or thin a woodlot or plantation?" Some data are available which indicate that it does pay, but sufficient information covering a great variety of conditions are not at hand.

From the two instances cited, it is obvious that stands resulting from these untreated plantings will be irregular and will fail to produce the maximum yield in quality and quantity at an early age. Low-forking, double-headed stems should be cut off at the ground. Their stumps will send up vigorous sprouts which in a few years will replace the stems removed. When several sprouts occur, all but the most vigorous may be removed.

In pruning, sharp saws or pruning shears should be used, since axes and hatchets invariably cause excessive damage. The cost of pruning varies. On an average, one man can prune an acre of young plantation in a day.

Thinnings.—Due to its intolerance of shade or need for sunlight, black locust losses begin to occur as soon as height differentiation takes place. This period coincides closely with the closing of crowns. From this time on, the slower growing stems become shaded and die. These losses act as thinnings and are beneficial to the stand.

From eight years of age on, fence posts will be produced (note Table 3). Thinnings and improvement cuttings will then pay for themselves. Suppressed, forked, crooked, rotting, or otherwise unhealthy and undesirable trees should be removed. Thinnings at this time will prove very beneficial to the stand and, in addition, a few fence posts may be secured, and fuel wood as well. Thinning should not be postponed until use for the material removed arises, if such waiting retards the growth of the stand to the point of serious injury. No thinnings should be made if large openings in the crown canopy result. In mixed plantings, opportunity is offered at this time to favor any particular species by removal of less desirable species.

Enemies

Black Locust Borer.—The activities of the locust borer, (*Cyllene robiniae Forst*) have limited the general planting of this species throughout the state. The insect usually can be found wherever locust grows in Pennsylvania. It causes the death of many young black locust trees, or riddles the heartwood. The adult beetles are black, ½ to ¾ inch in length, with yellow cross bands on their backs (4). They appear in late summer and autumn. The eggs are deposited in cracks and crevices of the rough bark of black locust trees. Young trees under 1½ to 2 inches in diameter and older trees over 5 to 6 inches in diameter appear to be comparatively unsusceptible to attack. It is believed a tree, once infested, remains subject to infestation regardless of size (5). The eggs hatch soon after they are deposited and the young larvae eat their way through the bark to the cambium. Here they feed and remain until the following spring, when they gradually bore into the heartwood of the tree. Shade trees and small plantations may be sprayed, A spray consisting of three or four pounds of arsenate of lead to fifty gallons of water and applied about the first of September, when the beetles begin to emerge

FIG. 5. POSTS WELL STACKED TO FACILITATE DRYING AND HANDLING. NOTE SNAGS WHICH SHOULD BE REMOVED FOR FIREWOOD

FIG. 6. PILE OF LOCUST POSTS, WITH ENDS PROTECTED TO PREVENT EXCESSIVE CHECKING

from the tree, has been recommended (4). A kerosene emulsion spray is also effective. The adult borer feeds on the pollen of golden rod; hence it is suggested as a means of reducing loss that all golden rod in the vicinity of locust planting be destroyed or sprayed with arsenate of lead in early September so as to destroy the beetles (4).

Tanglefoot bands mixed with sodium fluoride and sodium arsenite will kill all adults coming in contact with them. Old, badly infested locust trees in the vicinity of younger plantings serve as a breeding place for the borers and should be destroyed.

Control of this insect may be accomplished in several ways. The beetles are sun-loving and may be found basking in the sunlight on exposed parts of trees. Because of this habit, it has been found that trees whose trunks are shaded are immune from attack (1). Hence, injury by the borer may be avoided if dense stands are maintained. Plantings should be made sufficiently close to insure that the crowns meet before the trees attain a diameter of one and one-half inches. It also has been shown that comparatively isolated trees may be protected by surrounding growth of shrubbery or by vines climbing on the trunks (1). Grazing in locust plantations should be avoided if density of stand is to be maintained. Plantations that are badly infested with the borer should be clear cut and destroyed and a new stand developed from sprouts (5).

An examination was made of a 17-year-old plantation in which borers had, apparently, always been present. The average tree height was 11.3 feet and the average D. B. H., 1.4 inches. Another examination was made of an 18-year-old planting; this had an average height of 13.3 feet, with 2.0 inches D. B. H. These plots are typical of many badly infested areas where the borer has constantly reduced the stand to sprout growth. Healthy 17-year-old stands average 25.2 feet high and 4.1 inches D. B. H.

Leaf Miners.—In early fall the leaves of black locust often turn brown. This may be due to the activities of the locust leaf miner. There are 3 or 4 leaf miners common to black locust, the most active being the black and yellow hispa (*Chalepus dorsolis Thumb*) (4). These tiny insects eat the green coloring matter of the leaves, giving them a brown burned appearance. The damage usually is slight.

Rot Fungus.—A heart rotting fungus, (*Fomes rimosus*), is often found on black locust. Its presence in a stand may cause serious loss especially if infested trees are not utilized before the fungus spreads through the heartwood. Short rotations (10) and the removal of infested trees will tend to control the spread of the fungus.

Harvesting

Black locust is intolerant and, therefore, will not thrive in shade. For this reason, clear cutting should be followed in harvesting the crop. The practice of removing trees here and there or in small groups throughout the stand will result eventually in an open, unproductive woodlot of poorly shaped trees. Clear cutting can progress in strips or blocks through the grove, only sufficient material being harvested each time for current needs. It is a good plan to estimate the number of fence posts or types of material that will be needed during a period of from 3 to 5 years, and plan the plantation and cutting operations accordingly.

FIG. 7. CUT STUMPS LOW; HIGH STUMPS, SUCH AS THESE, GROW LOOSELY HELD SPROUTS WHICH ARE EASILY BROKEN OFF

Renewing the Plantation

Following clear cutting of a locust grove, the area is promptly claimed by sprouts, suckers, and seedlings. These will give rise to a new stand. Blank areas, if they occur, should be planted to insure a fully stocked stand in the future.

Sprouts.—Black locust sprouts grow readily from the stumps of young trees. The stumps of old trees often fail to produce sprouts. It has been the writer's observation that but little sprouting will follow the cutting of trees over 60 years old. Late fall and winter cutting will produce the most thrifty, firmly attached and hardy sprouts.

Sprouts arise from dormant buds on the stump and around the root collar next to the ground. Heavy losses often occur in young sprout growth because of high winds, or snow breaking the loosely held sprouts from the stumps. Sprouts arising from the root collar, or well down on the stump, become firmly attached sooner than sprouts arising higher on the stump. For this reason it is advisable to cut all stumps as close to the ground as possible (Fig. 4).

The number of sprouts per stump varies from one to ten or occasionally more (7) (Fig. 7). During the second or third year of growth, one or more of the sprouts become dominant, the others gradually dying from crowding and shading. Sprout data collected from 184 stumps show that there is no relation between age or size of trees cut and the number, size, or vigor of sprouts produced.

Sprouts grow rapidly in height. In one stand, clear cut three years ago, the average sprout height is now 14.4 feet with an average D. B. H. of 1.1 inches. During the third year, a portion of this stand was thinned for experimental purposes, leaving 1 or 2 sprouts per stump. The sprouts which were left average 15.5 feet in height and 1.4 inches D. B. H. (Fig. 8). When many sprouts arise on one stump, their interlocking branches tend to rub and cause wounds which may give rise to rot. Forking is as prominent in sprouts as in seedlings. It may be desirable, during the first few years of sprout growth, to prune or remove dominant forked stems that may develop into trees of poor form.

Suckers and Seedlings.—Black locust is one of the few species which produce root suckers freely. Following clear cutting of the stand, great numbers of suckers as well as seedlings appear. In Table 1 data on sucker and seedling growth two years after clear cutting are given. At the time of second cutting, trees that have started to produce suckers and seedlings will comprise over 25 per cent of the stand.

The treatment of second growth sprouts, suckers, and seedlings should be the same as that given the original plantation. Only those stems showing evidence of capacity to develop should be pruned, for they are the ones that will compose the new stand. The balance will gradually die.

The suckering habit of black locust often spreads it into areas where it is not wanted. Many farmers hesitate to plant black locust for fear it will encroach on adjacent fields. No positive restrictive measures are known, but it is believed that deep plowing around areas of locust will tend to control its spread.

Fig 8. A 3-Year-Old Stand of Black Locust Sprouts. The Seven Sprouts in the Center Average 17.6 Feet in Height and 1.5 Inches D. B. H.
(Compare with Fig. 9)

FIG. 9. THREE-YEAR-OLD BLACK LOCUST SPROUTS AFTER THE STAND HAD BEEN THINNED AND PRUNED. THE LARGE SPROUT IN THE FOREGROUND IS 20 FEET HIGH AND 2.8 INCHES D. B. H.
(Note type of shears used)

TABLE 1. SUCKER AND SEEDLING GROWTH ON BLACK LOCUST

Number and size of suckers and seedlings on a one-tenth acre plot two years after clear cutting

Height of suckers in feet	Number under ½ inch D. B. H.	Number over ½ inch D. B. H.	Total
3	108		108
4	88		88
5	160		160
6	52		52
7	44		44
8	24	20	44
9		8	8
	476	28	504

FIG. 10. FENCE POSTS THAT HAVE BEEN IN SOD GROUND FOR 55 YEARS

Growth and Yield of Black Locust Plantations

Growth data were secured on 21 plantations in Pennsylvania, representing a variety of site conditions. Over 40 plantations were visited, but because of the ravages of the locust borer and of fire, only 21 plantations were considered.

The plots averaged one-half acre in size. Stands varied in age from 5 to 70 years. Total heights and diameters (D. B. H.) at four and one-half feet above the ground were taken of all trees in the plots.

The following tables give the average of all plots. Insufficient data are available to classify the growth of black locust on different sites in Pennsylvania. Factors other than site have had an important bearing on the growth of the various plantations visited. Spacing varied and, unquestionably, had influenced the development of the stands. Borer damage had affected early growth. Fire had played an important part. Because of these influences and inability to give each factor due weight, only averages are considered. For sandy, rocky soils or north slopes, the figures in the tables are, doubtless, too high; while for fertile, moist, well drained soils, they are too low.

Table 2 gives average growth data, diameter of average tree at four and one-half feet above the ground, and total height, based on age. Thus the average tree in a plantation 25 years old would approximate 6.0 inches D. B. H. and measure about 35.8 feet in height. These figures were taken from average curves based on data from all plots.

TABLE 2.

Average growth figures based on age. Data plotted and figures read from average curves

Age yrs.	D. B. H. inches	Total height ft.
5	1.2	7.5
10	2.4	15.5
15	3.6	23.5
20	4.8	31.5
25	6.0	39.0
30	7.2	46.5
35	8.4	53.0
40	9.6	59.0
45	10.8	65.0
50	12.0	71.0
55	13.2	76.5
60	14.3	81.5
65	15.6	86.0
70	16.7	90.5

Yield data are presented in Table 3, showing probable yield of 8-foot fence posts of a 3-inch top diameter at various ages. With the exception of Plot 4, which was clear cut at 18 years, the number of posts was estimated. Maximum yearly yield in number of posts culminates at about 18 years of growth, when an average of 59 posts per year was produced.

Fig. 11. Black Locust is Used Most Commonly for Posts in Fencing. This Shows Locust Posts and Chestnut Rails

As the stands become older, more first and second-class posts are produced. It is estimated that at 18 years of age, 276 first-class posts will be cut, 462 second-class posts and 326 third-class. At 40 years of age, 1,119 first-class posts, 537 second-class, and 178 third-class posts will be produced. Thus, the class of fence posts harvested after 18 years of growth changes. This increase, however, does not compensate the owner in value returned for maintaining the stand the additional years if the product is harvested in fence posts.

Figuring the value of first-class posts at 35 cents, second class at 28 cents, and third class at 10 cents each, the average yearly return, exclusive of any costs, is $12.31 per acre at 18 years and $12.92 at 40 years. It is evident that, if the cost of carrying the stand an additional 22 years was also figured, the net returns would be considerably less at 40 years than at 18 years.

The data in Table 3 also show the trend of losses to be expected as the stand becomes older. The average yearly loss at 5 years is 3 trees, at 8 years 66 trees, at 18 years 46 trees, and at 40 years 21 trees. The greatest yearly loss occurs at about 8 or 10 years, or at the period when the crowns are closing and intensive competition for moisture and light begins.

A simple volume table is given in Table 4, based on diameter only. First-class posts were considered as those having a top diameter of 4½ to 6 inches, second-class 3½ to 4½ inches, and third-class 2½ to 3½ inches. It was further estimated that two first-class posts could be obtained from logs having a top diameter of 6 to 9 inches and three first-class posts from logs having a top diameter of from 9 to 12 inches.

TABLE 3. Yield of 8-foot fence posts to 3-inch top diameter, on eight different plots, at various ages

The data also show the number of trees surviving at different ages and spacing on these plots

Age yrs.	*Spacing ft.*	*No. planted per acre*	*No. of trees per acre now*	*Per cent survival*	*No. 8'-3" fence posts per acre*	*No. fence posts per acre per year*
5	6 x 6	1,210	1,192	98	0	0
7	5 x 4	2,178	1,236	57	0	0
8	6 x 6	1,210	680	56	58	7
18	6 x 6	1,210	384	32	1,064	59
26	10 x 10	435	284	66	1,252	48
26	10 x 10	435	248	57	1,311	50
40	6 x 6	1,210	324	27	1,834	46
40	6 x 6	1,210	368	30	1,901	47

Table 4 shows the average number of posts, by classes, to be cut from average trees of different diameters. Five trees having a diameter of 4 inches and three trees having a diameter of 6 inches will cut out approximately 6 first-class posts, 9 second-class posts, and 9-third-class posts. Average heights for trees of these diameters can be determined from Table 2.

TABLE 4. THE NUMBER OF FENCE POSTS, BY CLASSES, OBTAINABLE FROM AVERAGE TREES, BASED ON DIAMETER

Tree	*Number of 8-foot fence posts*			
Dia. D. B. H. inches	*Class one*	*Class two*	*Class three*	*Total no. of posts*
3			1.0	1.0
3.5			1.3	1.3
4		1.0	1.0	2.0
4.5		1.0	1.1	2.1
5	1.0	1.5	1.1	3.6
5.5	1.5	1.2	1.1	3.8
6	1.9	1.4	1.2	3.5
6.5	2.4	1.7	1.3	5.4
7	2.8	1.7	1.4	5.9
7.5	3.3	1.8	1.0	6.1
8	3.8	2.0	1.0	6.8
8.5	4.2	2.2	1.0	7.4
9	4.7	2.2	1.1	8.0
9.5	5.2	2.5	1.2	8.9
10	5.6	2.1	1.0	8.7
10.5	6.1	2.2	1.5	9.8
11	6.5	2.4	1.3	10.2
11.5	7.0	2.3	1.3	10.6
12	7.5	2.2	1.0	10.7
12.5	7.9	2.0	1.0	10.9
13	8.4	2.6	1.0	12.0

Financial Returns

The State Forestry Department of Maryland estimates the stumpage value of black locust at 20 years of age, in normal times, at $200 or more for the average acre (10).

In 1842 John M. Ham, of Dutchess county, New York, set out a 6-acre black locust plantation with seedlings he had grown. About 50 years later $1,500 worth of cribbing material was sold. The fencing material used on the farm for 70 years came from this grove as well as the sills used in building a new house and barn (3).

In 1926, an 18-year old black locust plantation established by The Pennsylvania State College, was clear cut for fence posts. The plantation yielded 1,064 round posts per acre. At a value of 25 cents per post, $265 per acre was realized. The cost of planting and care is estimated at $50, which includes interest on the investment. This leaves a net profit of $11.94 per acre a year.

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